

5

shown in FIG. 4, only the quadrature birdcage coil 60 is activated; the cervical spine coils 70 and the anterior neck coils 80 and 90 are electrically disabled. The MRI system operates in phased array mode. The HIGH RESOLUTION BRAIN imaging mode may be used for all types of brain and/or head imaging, other than echo planar imaging, but is especially useful for high resolution studies of the brain. The HIGH RESOLUTION BRAIN imaging mode is also useful for high resolution Circle of Willis imaging. The preferred embodiment shown in FIG. 4 provides a field of view of up to 24 cm.

High Speed Brain Mode

The HIGH SPEED BRAIN mode routes the two quadrature modes of the head birdcage resonator 60 through the combiner circuit in the coil interface 100 to produce one signal containing the signal from both quadrature modes. In FIG. 2A, the combined signal is provided to the MRI system at port #5. The combined signal drives one channel of the phased array system [preferably Receiver 0 (Receiver selection 1 on LX systems) for the GEMS Signa system] to minimize reconstruction time or to allow the use of a single FAST receiver. All other coil elements are electrically disabled.

FIG. 5 is a wire model of the phased array neurovascular coil 50 in HIGH SPEED BRAIN mode. Like FIG. 4, only the quadrature birdcage coil 60 is activated; the cervical spine coils 70 and the anterior neck coils 80 and 90 are electrically disabled. The HIGH SPEED BRAIN mode may be used for Echo Planar Imaging and/or vascular or other studies of the brain where decreased acquisition time is desirable. HIGH SPEED BRAIN mode is also useful for imaging the Circle of Willis.

Additional modes of operation for the phased array neurovascular coil 50 may be used by providing the MRI system with the appropriate port masks for the coil interface 100. For example, embodiments of the phased array neurovascular coil 50 may also acquire images from one or more of the following operational modes: HIGH RESOLUTION BRAIN AND CERVICAL SPINE, CERVICAL SPINE and VOLUME NECK. Each of these modes is described in further detail below. For these alternative embodiments, unless otherwise noted, it is assumed that the cervical spine coils 70 are applied separately to the coil interface, rather than being combined at the RF level, and the anterior neck coils 80 and 90 are either combined to provide a single input to the coil interface or replaced by a single anterior neck coil.

High Resolution Brain and Cervical Spine Mode

This mode activates the head and posterior cervical spine coils, and disables the anterior neck coil. This allows focal studies of the brain, brain stem, spinal cord, and cervical spine. The two quadrature components of the MR signal from the birdcage coil 60 each drive a separate receiver channel for optimum uniformity and signal to noise ratio performance. The combiner circuit is electrically disconnected to allow independent reconstruction of the data from the two channels. The two posterior cervical spine coils 70 also each drive a separate receiver channel.

Cervical Spine Mode

In CERVICAL SPINE mode, the two quadrature components of the MR signal from each of the two posterior cervical spine coil elements 70 each drive a separate receiver channel for optimum uniformity and signal to noise ratio performance. The head coil element 60 and the anterior neck coil 80, 90 are electrically disabled to minimize artifacts and undesirable coil interactions.

Volume Neck Mode

This mode disables the tapered birdcage coil covering the head region, and activates the three spine region coils to

6

form a volume acquisition of the neck region. The two quadrature components of the MR signal from each of the two posterior cervical spine coil elements 70 and the anterior neck coil 80, 90 each drive a separate receiver channel for optimum uniformity and signal to noise ratio performance. In one embodiment, the MR signals from the two posterior cervical spine coils 70 are combined at the RF level and applied as a single input to the coil interface 100, along with the two MR signals from the anterior neck coils 80 and 90. For embodiments in which the anterior neck coils 80 and 90 are combined at the RF level, the cervical spine coils 70 are combined at the RF level, or only a single anterior neck coil is used, the acquisition uses an unoccupied channel for the fourth channel [GEMS Signa does not directly support a three coil acquisition; Phased Array Data sets must be from one, two, or four receivers].

As noted above, selection of the modes is made in the coil interface 100 unit by the use of PIN diode RF switches; the switches either direct the two quadrature signals from the two modes of the birdcage coil element 60 to two separate MR receivers, or combine them with a relative phase difference of 90° and direct them to a single receiver. Determination of which mode to support is made via detection of the bias pattern of the ports in the host GEMS Signa MRI system. As will be apparent to those skilled in the art, the electrical length of the path of the various MR signals through the coil interface 100 should be compensated to ensure that the MR signals may be properly combined by the MRI system. For example, the electrical lengths of the paths through the coil interface 100 may be adjusted to be an integer multiple of half wavelengths.

In view of the wide variety of embodiments to which the principles of the present invention can be applied, it should be understood that the illustrated embodiments are exemplary only, and should not be taken as limiting the scope of the present invention. For example, the steps of the design method may be taken in sequences other than those described, and more or fewer elements may be used than are described. In addition, although reference is made herein to the GEMS Signa MRI system, other systems having similar capabilities may alternatively be used to receive and process signals from the coils described above.

I claim:

1. A coil interface for coupling a plurality of coil elements in a phased array magnetic resonance imaging coil to a host magnetic resonance imaging system, comprising:

a plurality of signal inputs for coupling to the plurality of coil elements;

a plurality of output ports for coupling to predetermined receivers of the host magnetic resonance imaging system; and

a interface circuit that in a first imaging mode selectively couples at least two signal inputs to an equal number of output ports, and, in a second imaging mode, selectively couples at least two signal inputs to a lesser number of output ports.

2. A coil interface as claimed in claim 1, wherein the interface circuit is remotely configured to couple said plurality of signal inputs to a predetermined sequence of output ports.

3. A coil interface as claimed in claim 1, wherein said plurality of signal inputs comprises an in-phase MR signal and a quadrature MR signal from a quadrature birdcage coil.

4. A coil interface as claimed in claim 3, wherein said interface circuit is remotely configured to couple said in-phase MR signal input and said quadrature MR signal input to a single predetermined output port.

7

5. A coil interface as claimed in claim 3, wherein said interface circuit is remotely configured to couple said in-phase MR signal input to a first predetermined output port and to couple said quadrature MR signal input to a second predetermined output port.

6. A coil interface as claimed in claim 1, wherein said plurality of signal inputs exceeds said plurality of output ports in number.

7. A coil interface as claimed in claim 1, wherein a conductive path through said interface circuit between an input from the plurality of signal inputs and an output port from the plurality of output ports has an electrical length that is equal to an integer multiple of half wavelengths.

8. A coil interface as claimed in claim 1, wherein said interface circuit comprises a remotely operable PIN diode switch and a 90° phase shift.

9. A coil interface as claimed in claim 8, wherein PIN diode switch is operable from an operator's console for the magnetic resonance imaging system.

10. A coil interface as claimed in claim 1, wherein a first signal input comprises an in-phase magnetic resonance signal from a quadrature coil element within said plurality of coil elements and a second signal input comprises a quadrature magnetic resonance signal from the quadrature coil element.

11. A coil interface as claimed in claim 10, wherein said first signal input is coupled to a first output port and said second signal input is coupled to a second output port, in accordance with the first mode of operation.

12. A coil interface as claimed in claim 10, wherein only one of said first signal input and said second signal input is applied to a phase shifter, producing a phase shifted signal input and a remaining signal input.

13. A coil interface as claimed in claim 12, wherein said phase shifted signal input and said remaining signal input are combined and then applied to a single output port, in accordance with the second mode of operation.

14. A method of operating a quadrature phased array MR coil in a plurality of imaging modes, comprising:

8

providing an interface circuit that selectively couples a plurality of elements of the quadrature phased array MR coil to a host MRI system, wherein the plurality of elements comprises at least one quadrature element, the at least one quadrature element generating an in-phase MR signal output that is coupled to the interface circuit and a quadrature MR signal output that is coupled to the interface circuit;

selecting a first imaging mode from the plurality of imaging modes; and

responsively configuring the interface circuit to couple the in-phase MR signal output to a first receiver in the host MRI system and to couple the quadrature MR signal output to a second receiver in the host MRI system.

15. A method as claimed in claim 14, further comprising the step of disabling unused coil elements in the quadrature phased array MR coil in accordance with the selection of the imaging mode.

16. A method as claimed in claim 14, wherein the step of configuring the interface circuit comprises adjusting a state of a radio frequency switch.

17. A method as claimed in claim 16, the state of the radio frequency switch causes an in-phase MR signal output from a quadrature element of the quadrature phased array MR coil to be routed to a first receiver input, and causes a quadrature MR signal output from the quadrature element to be routed to a second receiver input.

18. A method as claimed in claim 16, wherein the state of the radio frequency switch causes an in-phase MR signal output from a quadrature element of the quadrature phased array MR coil to be combined with a quadrature MR signal output from the quadrature element forming a combined MR signal, the combined MR signal being coupled by the interface circuit to a single receiver input.

19. A method as claimed in claim 18, wherein said single receiver input comprises a FAST receiver input.

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